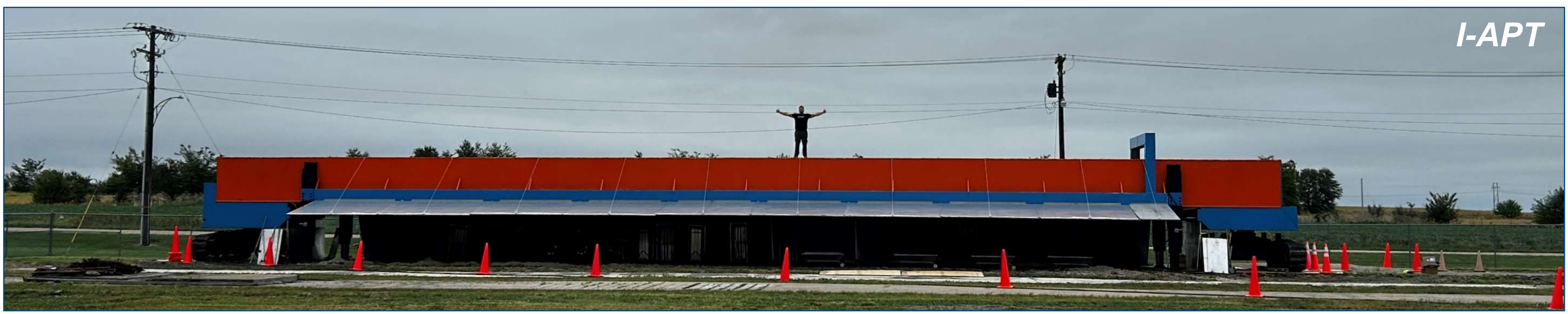
Illinois Center for Transportation
University of Illinois at Urbana-Champaign

ILLINOIS

Accelerated Pavement Testing (APT) of Stone Matrix Asphalt (SMA) with Local Aggregate

Dec 11th, 2024 – Illinois Bituminous Paving Conference



“Where Excellence and Transportation Meet”

Introduction

- SMA is a durable paving material.
- The use of SMA is gaining momentum.
- SMA requires fiber, SBS, more binder, and high-quality aggregates, which make it cost more than HMA.
- If aggregates were hauled locally, SMA production would
  - cost ~20% less
  - emit ~10% less

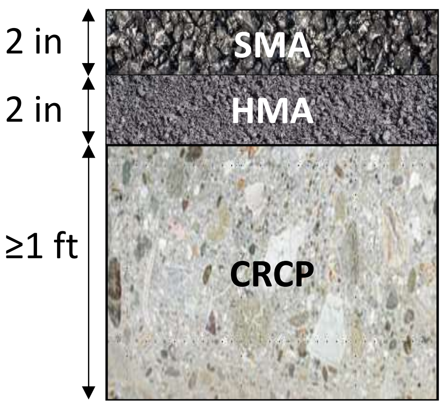
Optimize SMA by using Local Aggregate

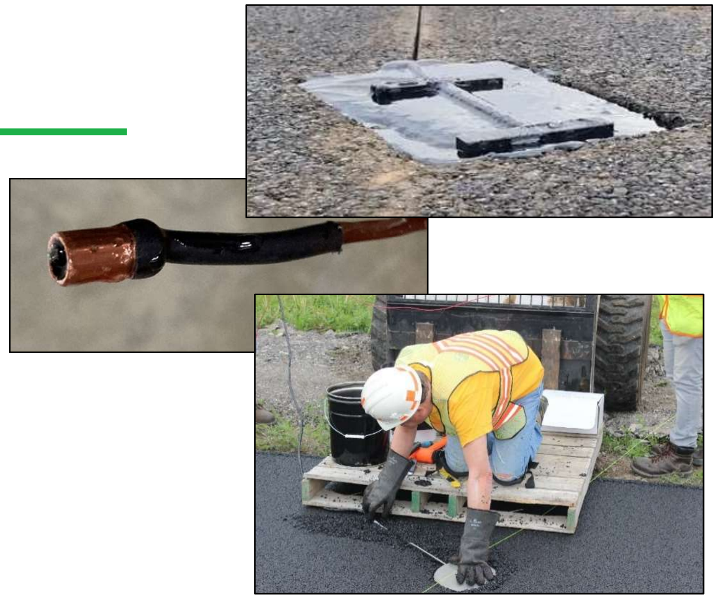
- **Objective: Reduce the cost and environmental impact of SMA**
- **Designed 21 SMAs in the laboratory**
  - Reduced compaction effort to accommodate aggregates meeting lesser quality standards
  - Evaluated aggregate skeleton preservation (check breakage)
  - Potential performance
- **Full-scale validation of six selected SMAs**

Six SMA Design Characteristics

SMA	Aggregate Lithology	Design Gyrations	Nominal Maximum Aggregate Size (mm)	Combined Water Absorption (%)	Combined L.A. Abrasion (%loss)	Binder Content (%)	Effective Binder Content (%)	Voids in Mineral Aggregate (%)
T1-80-12.5-0	Trap Rock	80	12.5	1.07	11.1	6.0	5.4	16.3
T1-50-12.5-0	Trap Rock	50	12.5	1.11	10.9	6.3	5.6	16.8
D2-50-12.5-0	Dolomite	50	12.5	2.73	13.6	7.0	5.5	16.5
L2-50-12.5-0	Limestone	50	12.5	1.71	16.8	6.4	5.6	16.7
D3-50-9.5-0	Dolomite	50	9.5	2.26	21.5	7.0	5.9	17.4
D4-50-12.5-0	Dolomite	50	12.5	2.24	18.2	6.8	5.5	16.6

Full-scale Testing Sections

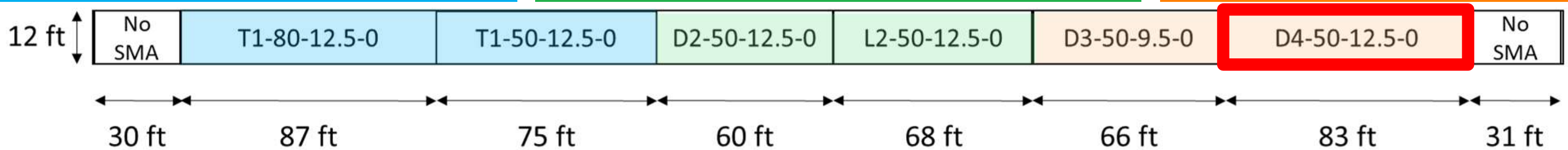




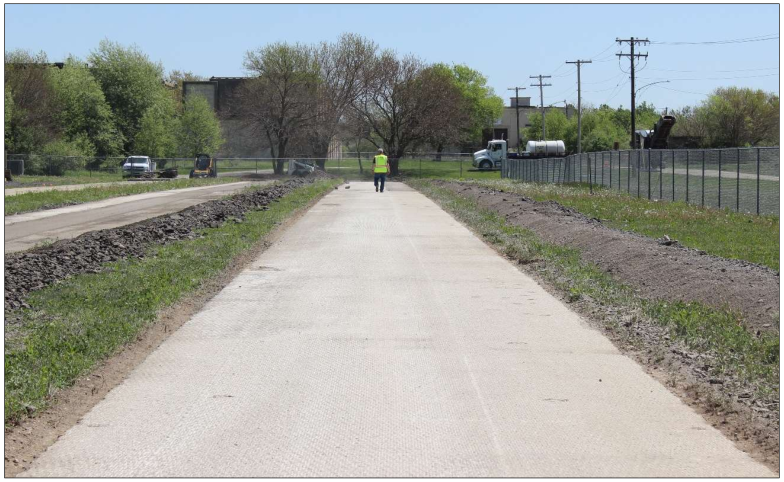
- Compaction Effort
- Imported Agg.

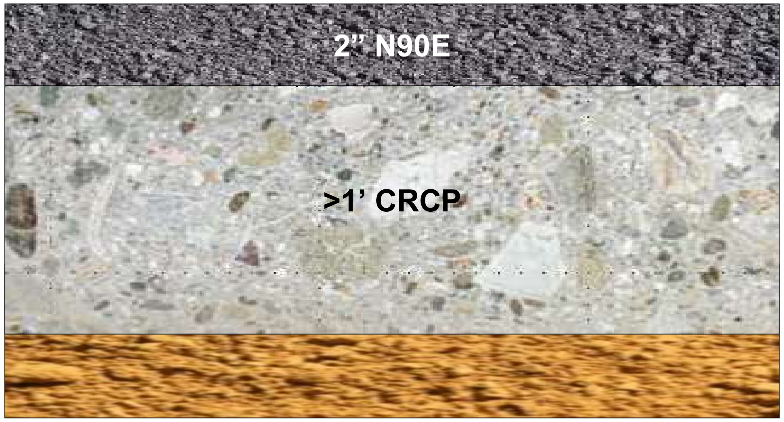
- Limestone vs Dolomite
- Best Available Agg.

- Different Agg. Qualities
- Dolomite

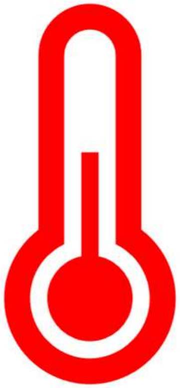


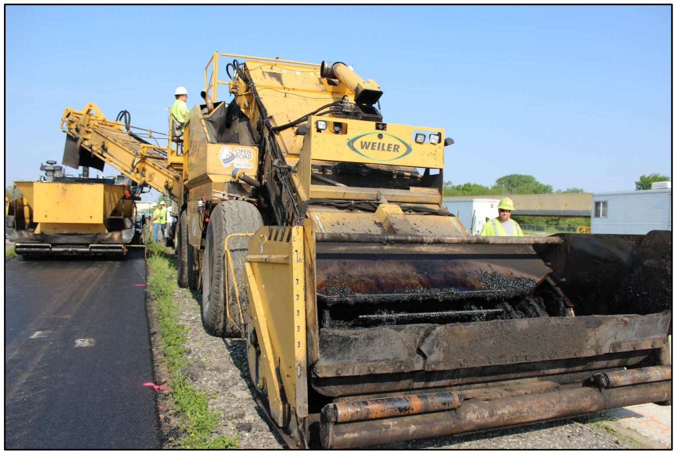
Base Preparation





SMA Instrumentation






MACK


HD+110i
OSCILLATION

Illinois Accelerated Pavement Tester I-APT

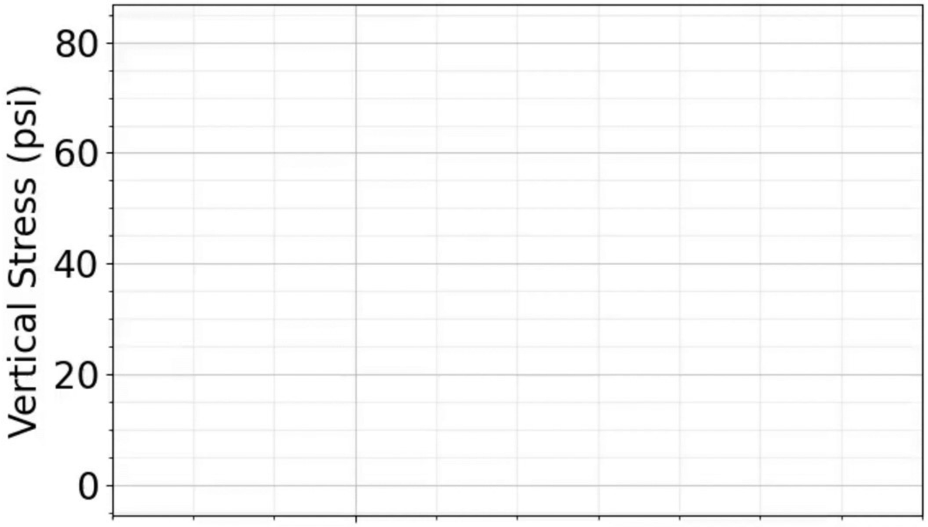
[redacted]

Experimental Program

- **19 Loading Scenarios (passes to stability)**
  - Axle Loading: Single or Tandem
  - Loading Level: 7, 8, 9, or 10kip
  - Tire Inflation Pressure: 120, 100, or 80psi
  - Speed: 1, 3, or 5mph
- **Rutting at 5mph**
  - Tandem spaced 3.5ft c-c
  - Temperature: 80°F
  - Loading: 10, 12, and 14kip/axle for 60k, 30k, and 30k, respectively.
  - Tire Inflation Pressure: 120psi (both tires)

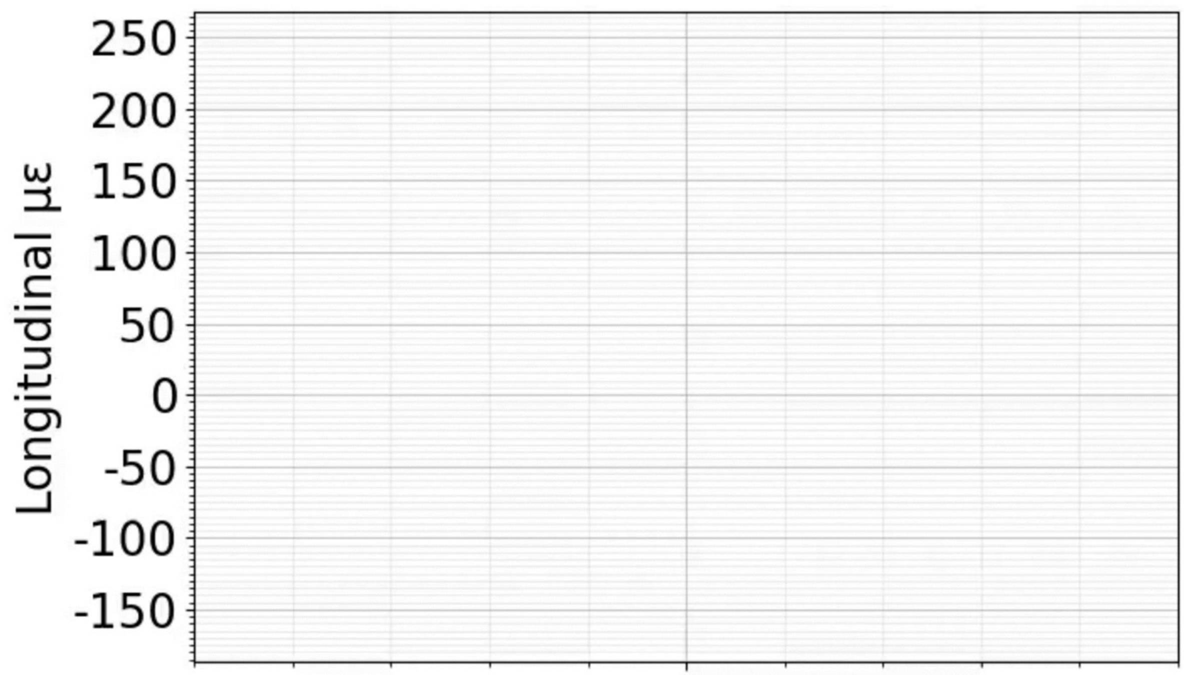
Data Collection

Vertical Pressure

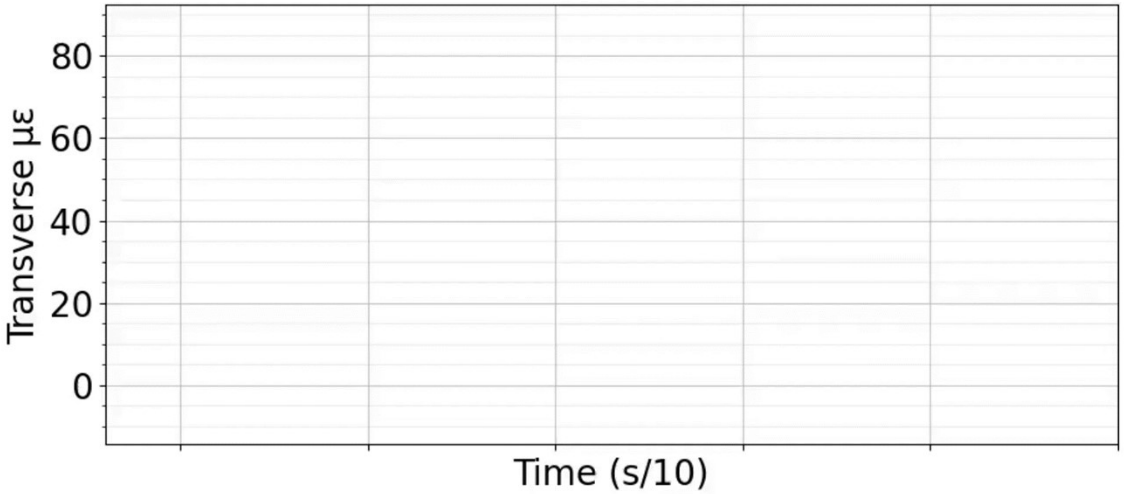


Longitudinal Strain

<<

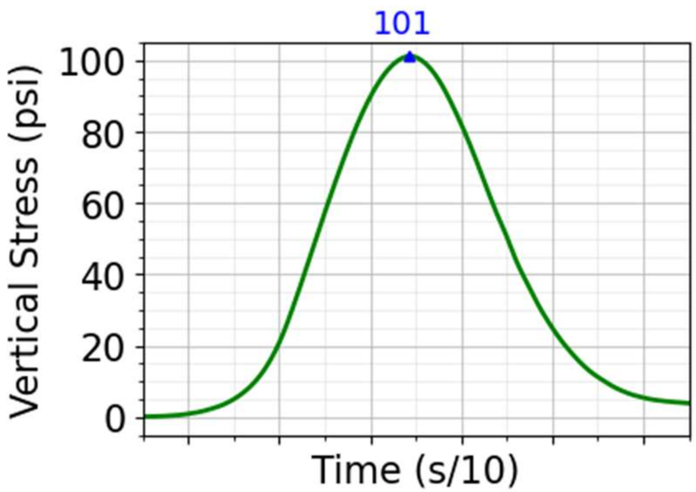


Transverse Strain

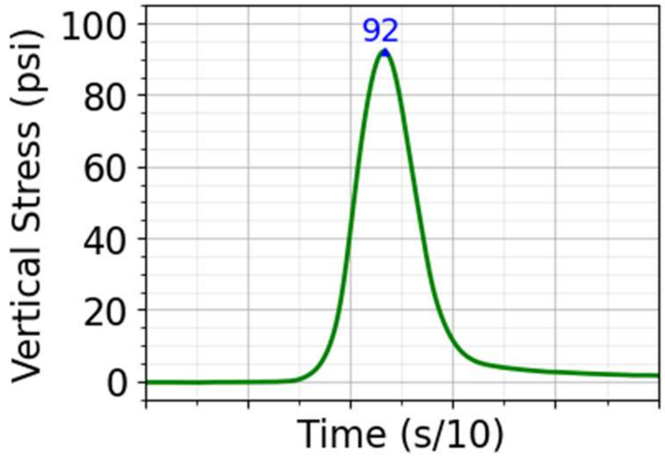


Effect of Speed on Vertical Pressure

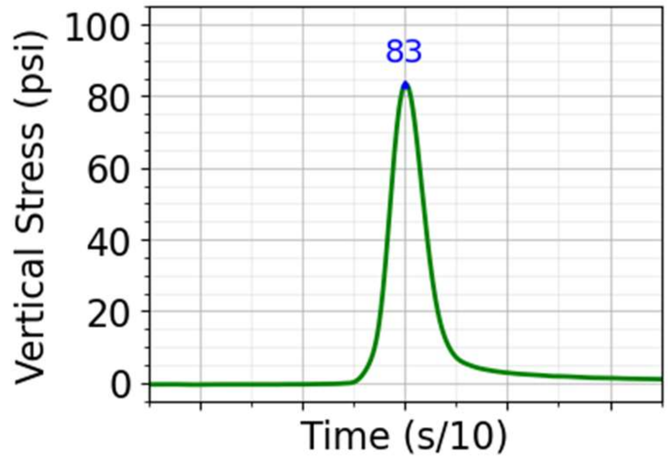
1mph



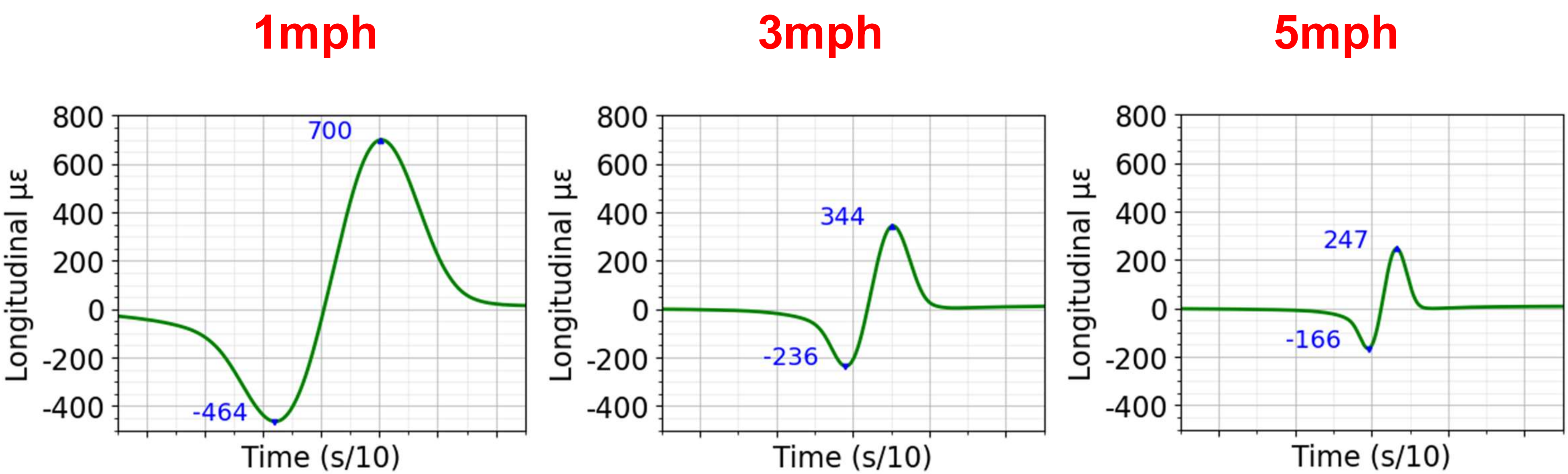
3mph



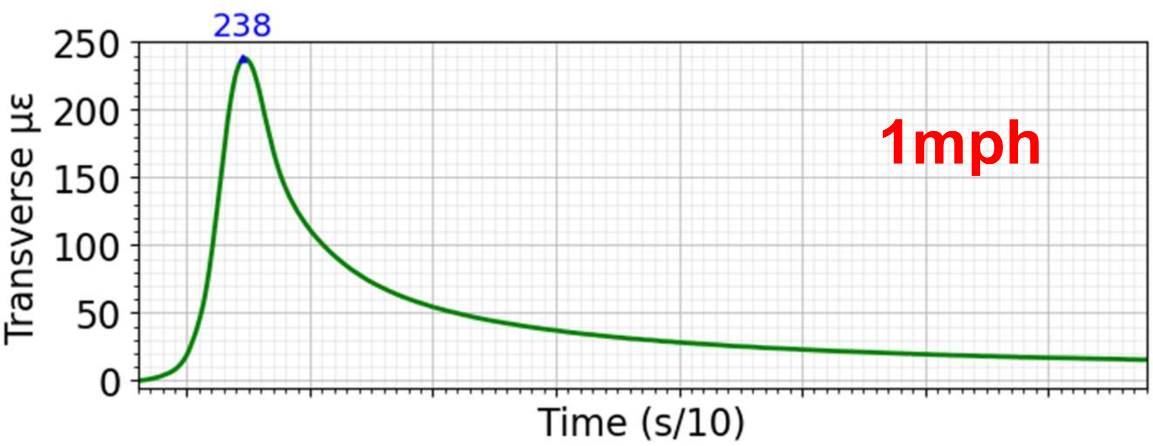
5mph

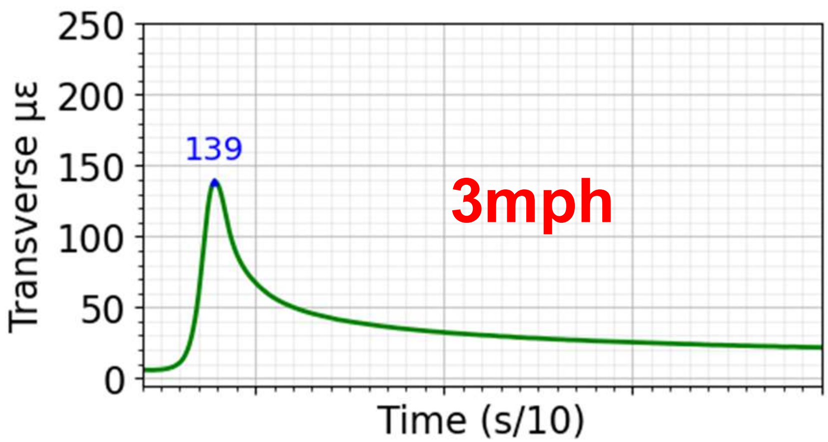


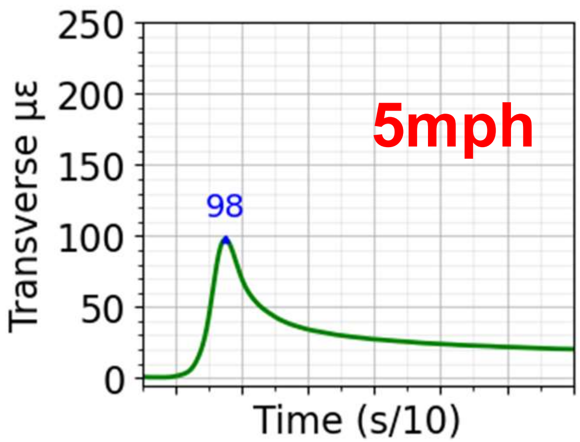
Effect of Speed on Longitudinal Strain



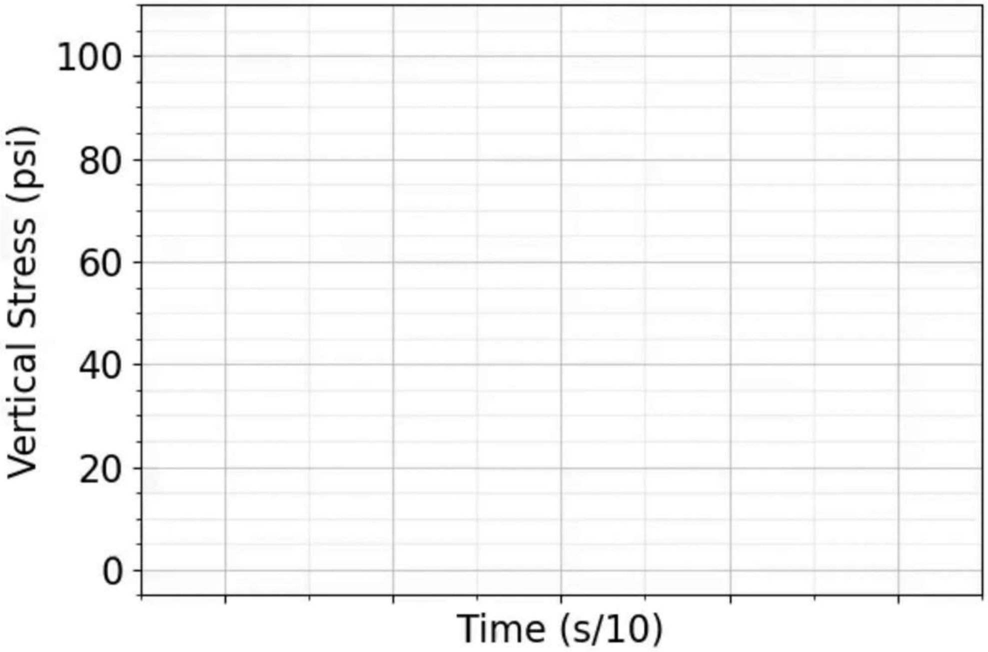
Effect of Speed on Transverse Strain



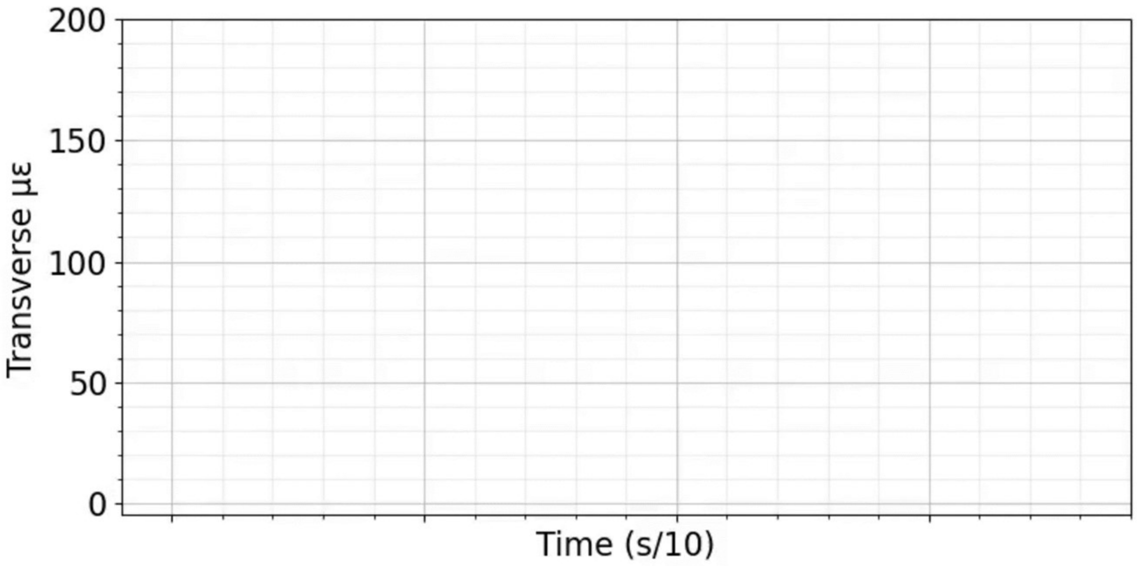


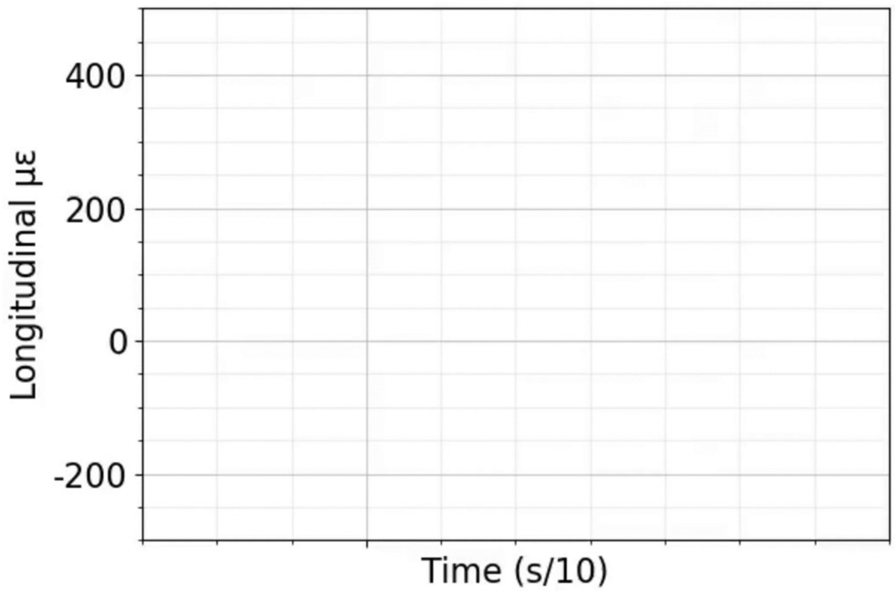


Effect of Tandem Axle on Vertical Pressure

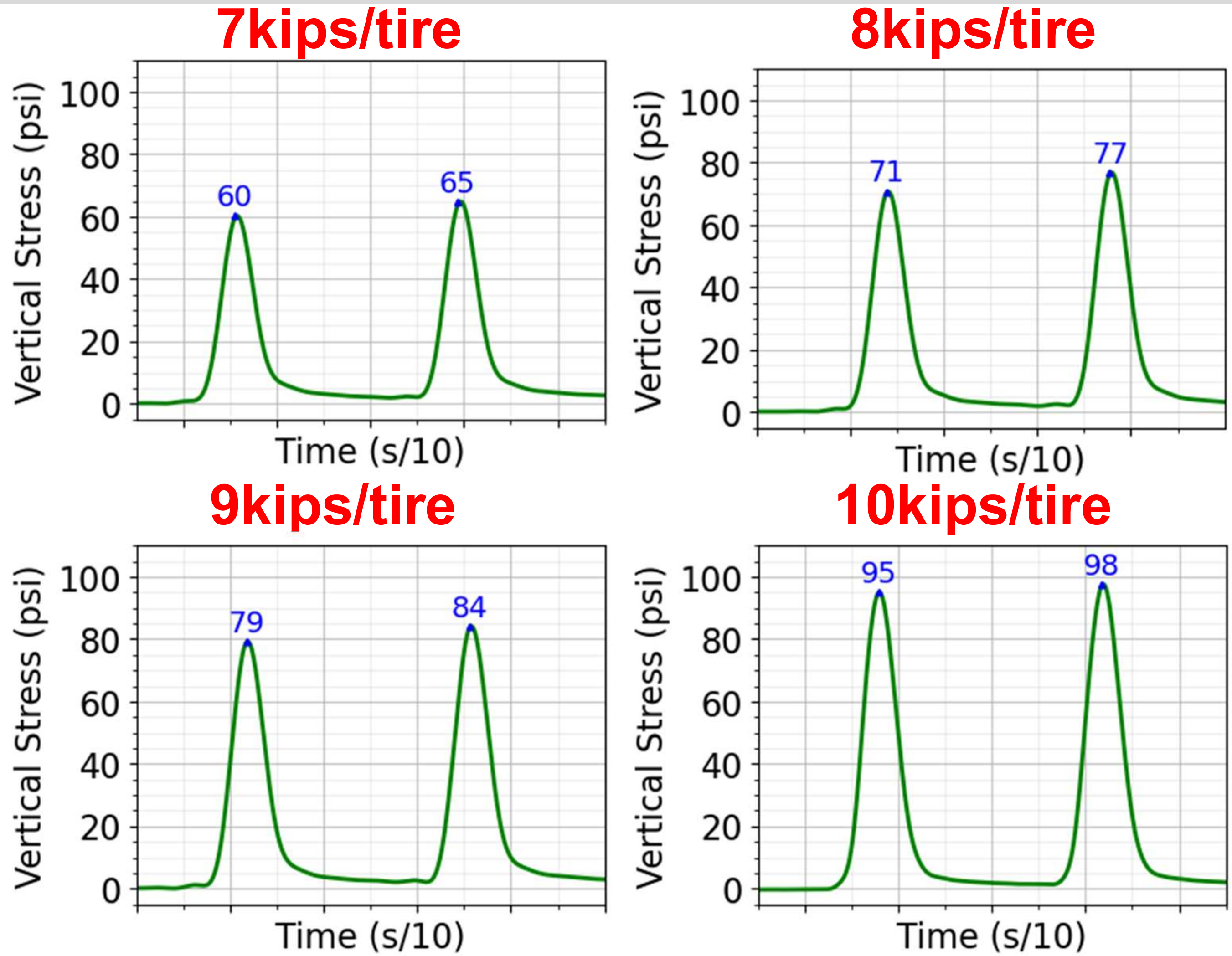


Strains due to Tandem Axle Loading

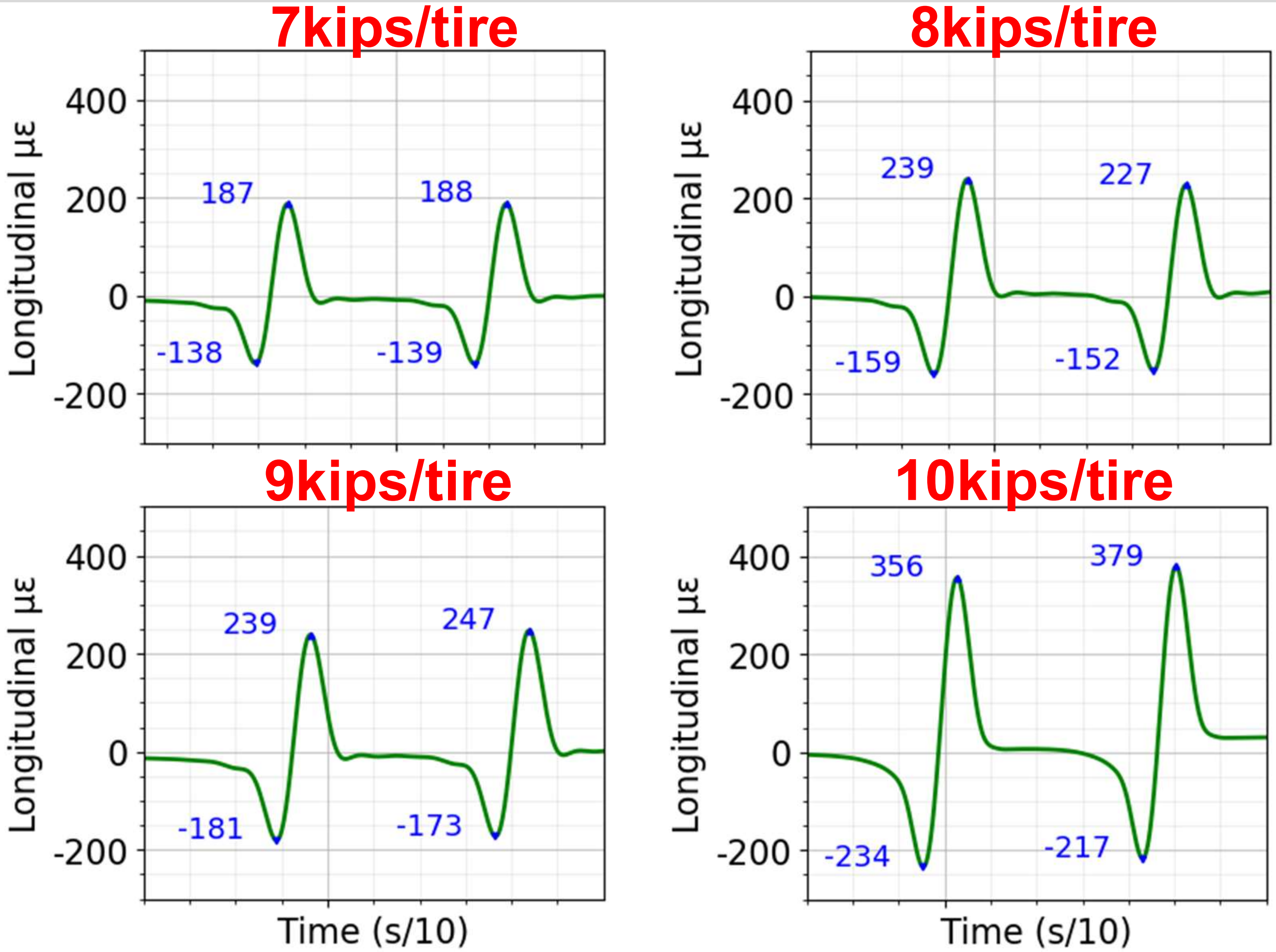




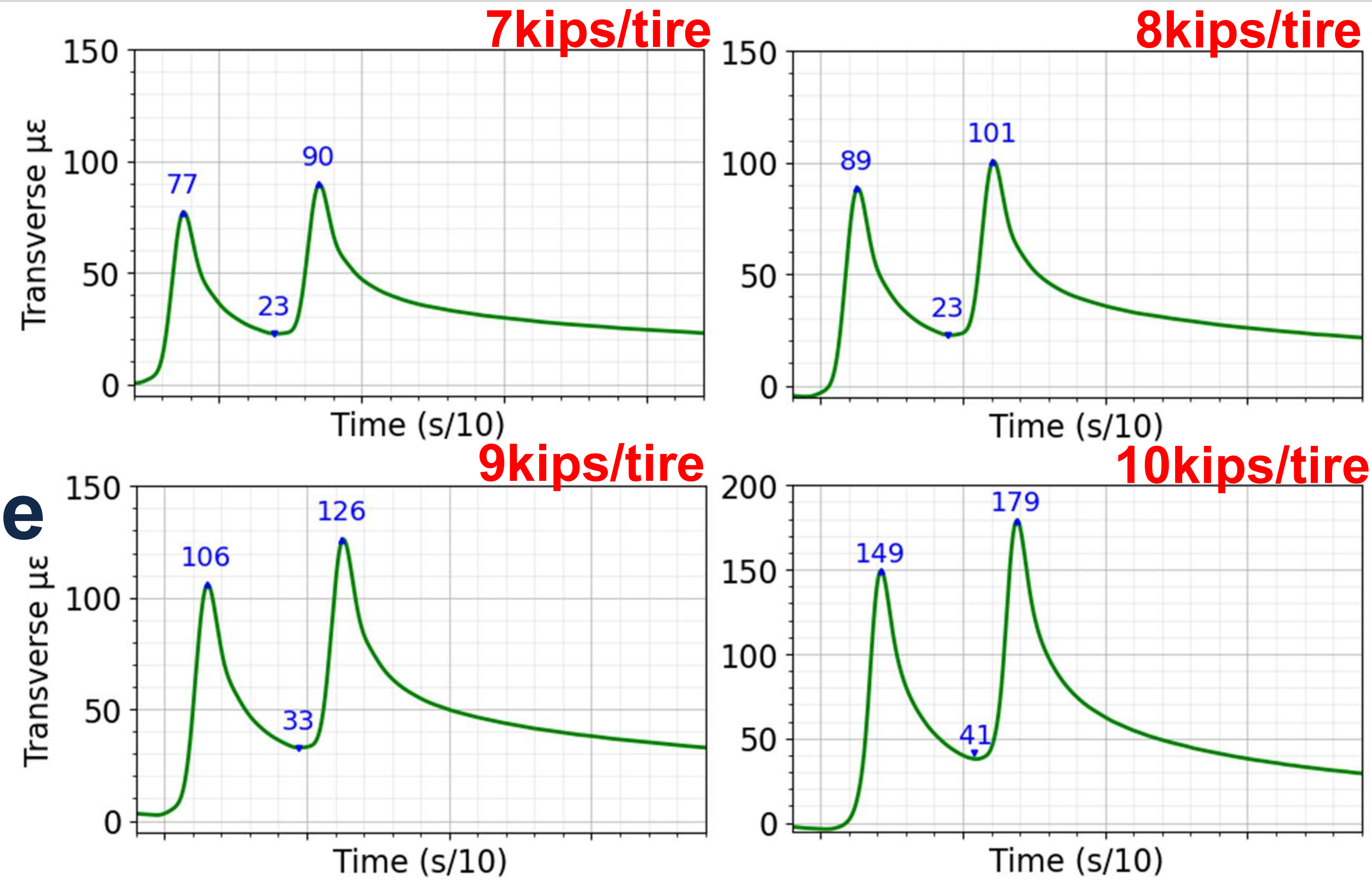
Effect of Tandem Axle on Vertical Pressure



Effect of Tandem Axle on Longitudinal Strain

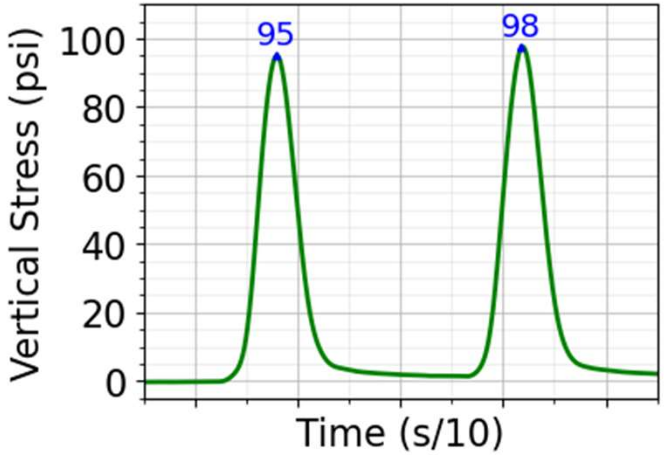


Effect of Tandem Axle on Transverse Strain

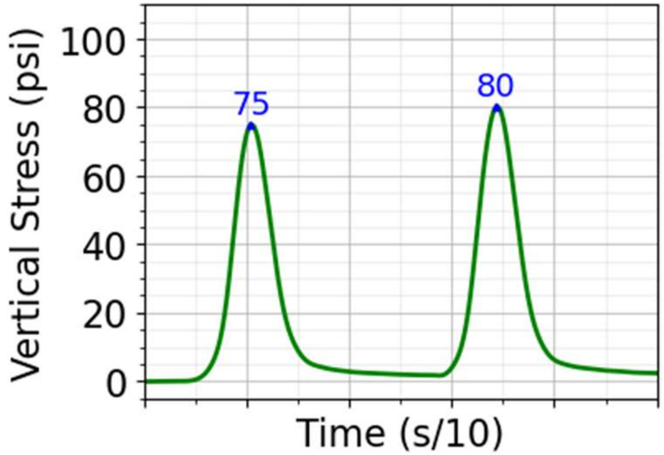


Tire Inflation Pressure Effect on Near Surface

120 + 120psi



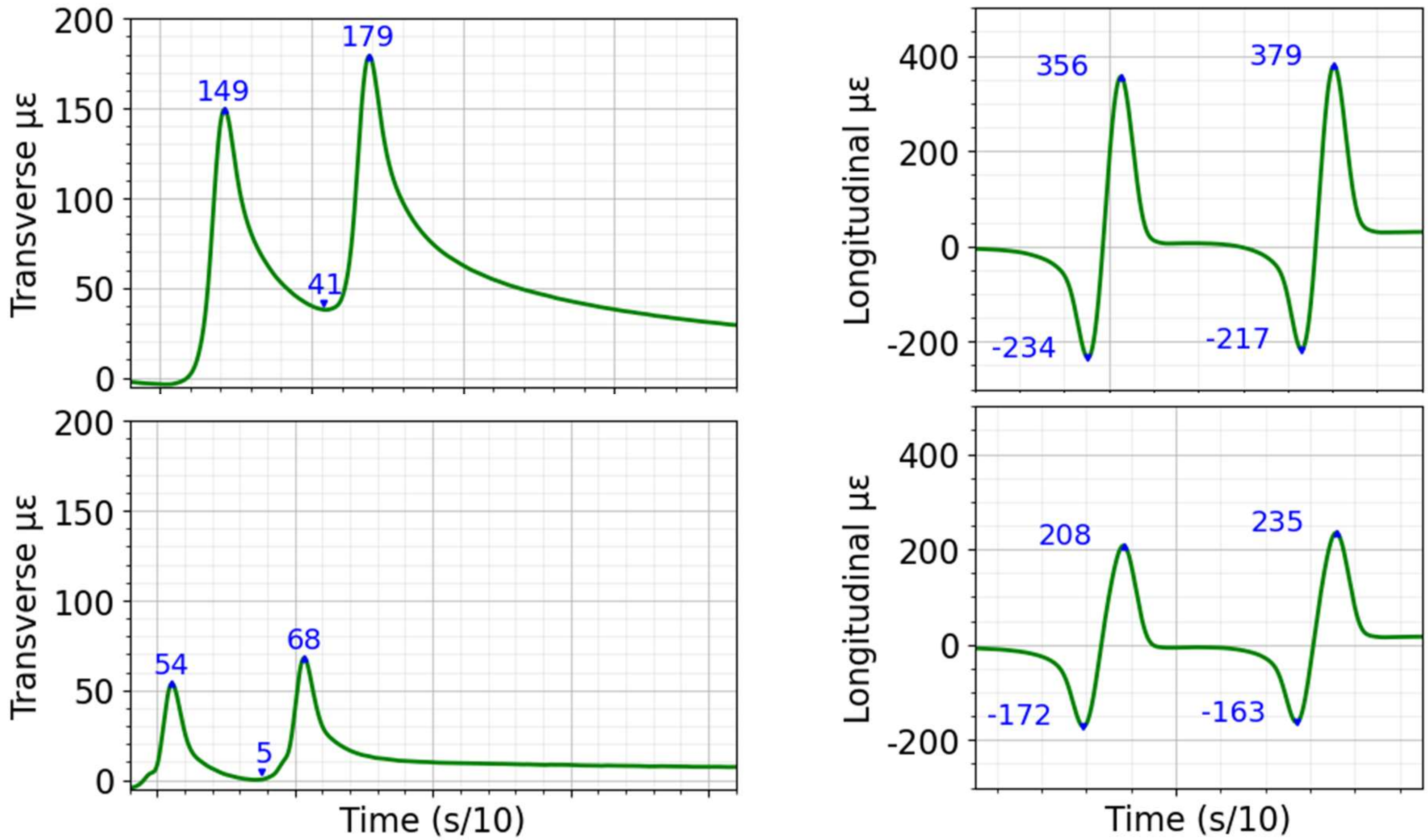
80 + 80psi



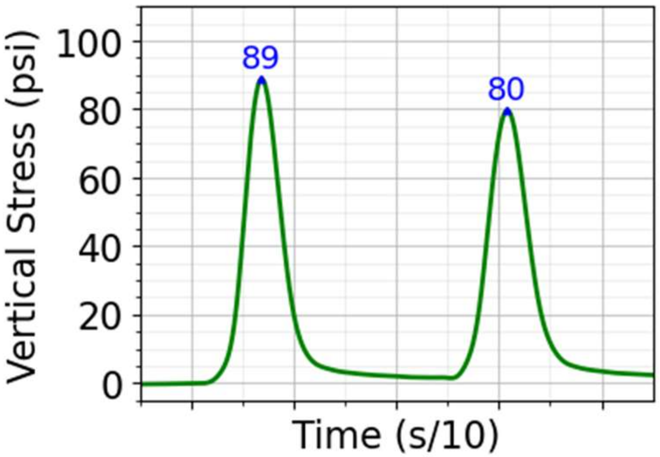
Effect of Tire Inflation Pressure on Strains

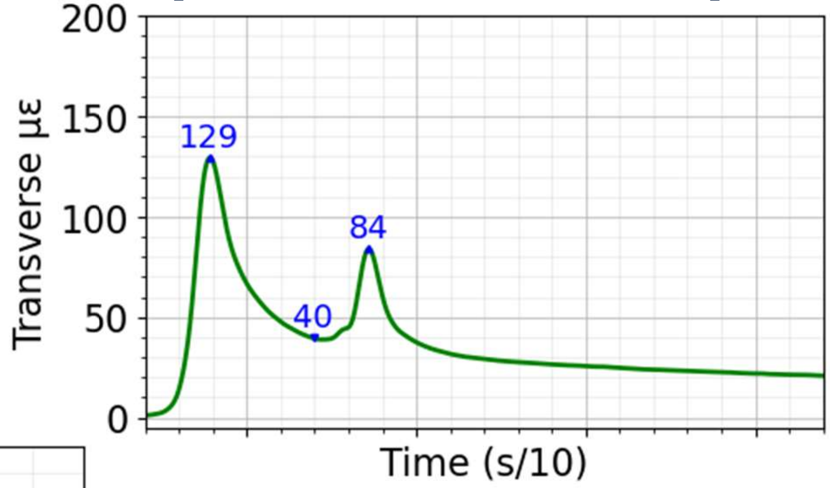
120psi
120psi

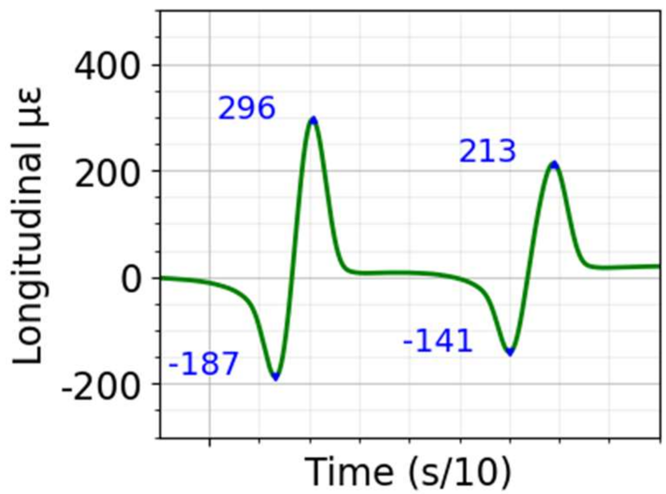
80psi
80psi



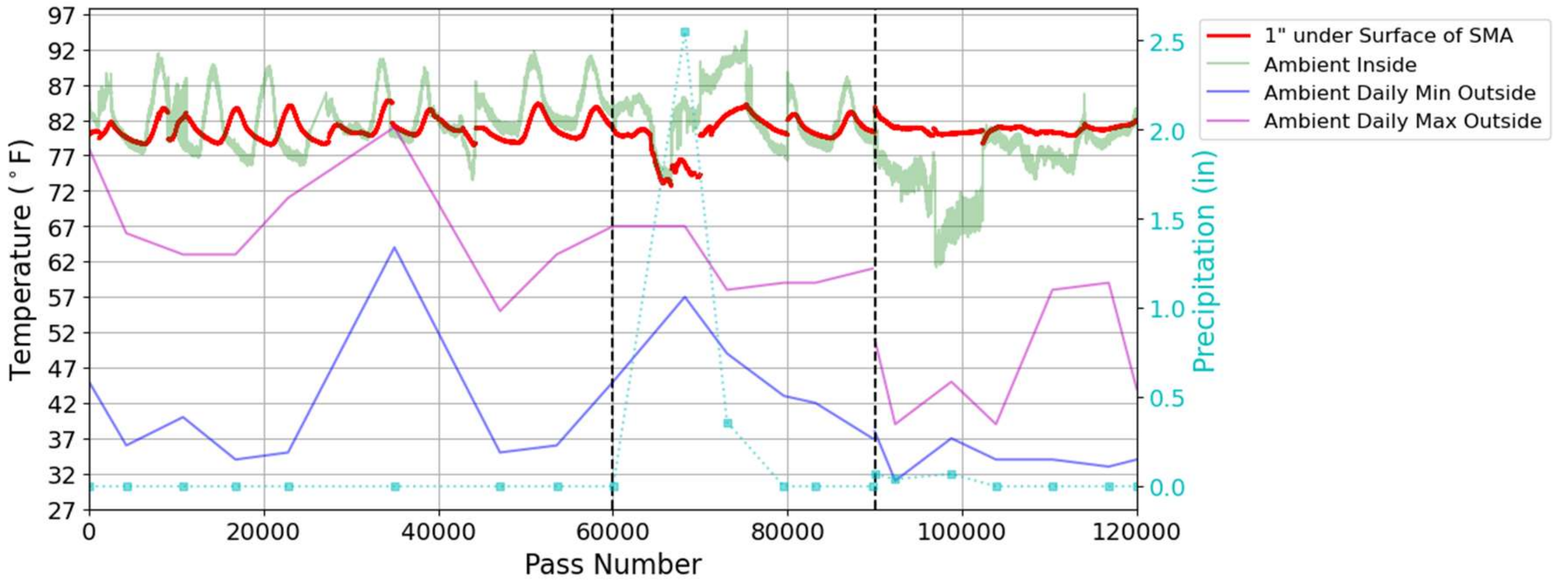
Deflated One Tandem Tire (120 + 80psi)



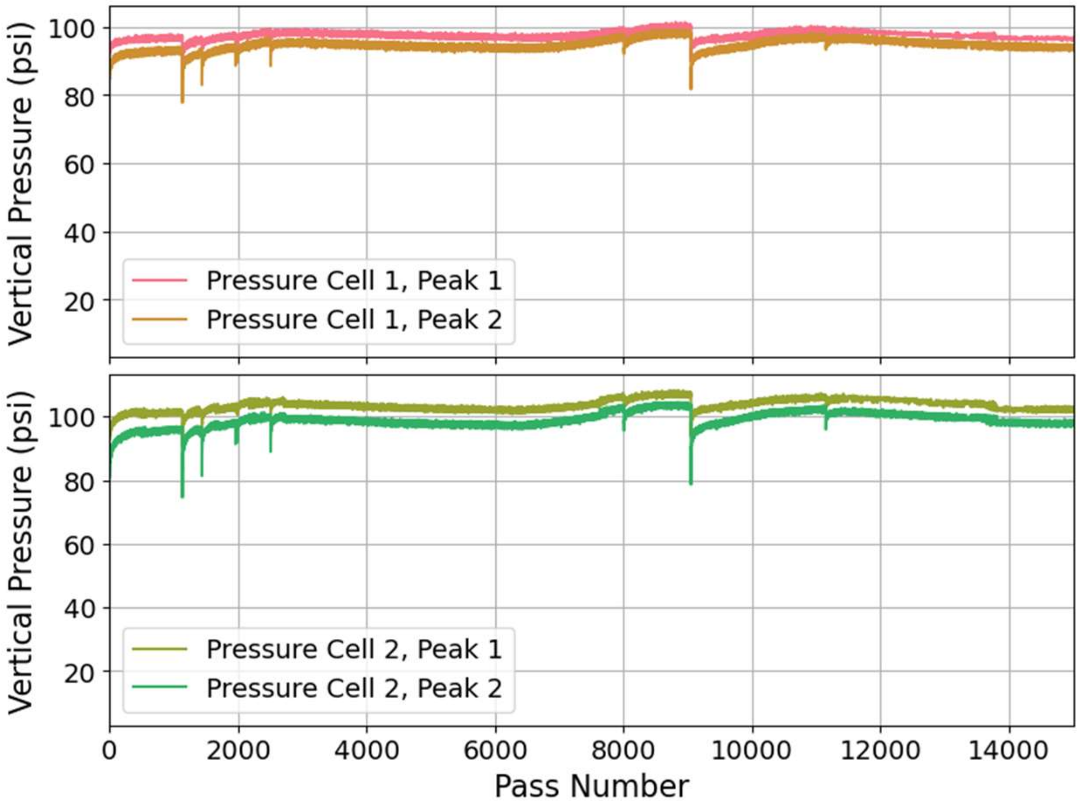




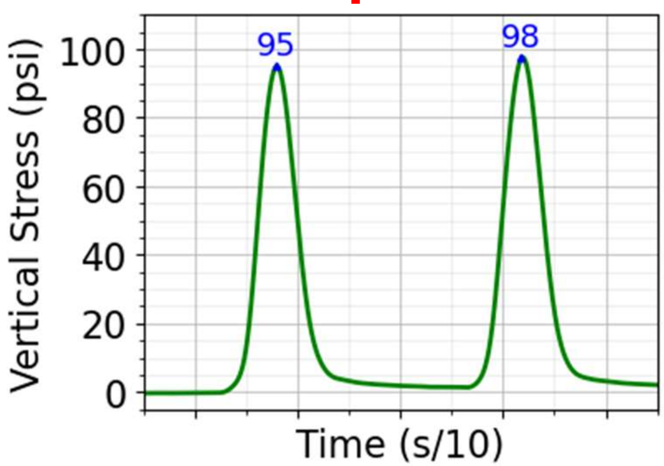
Temperature Control (Rutting Test)



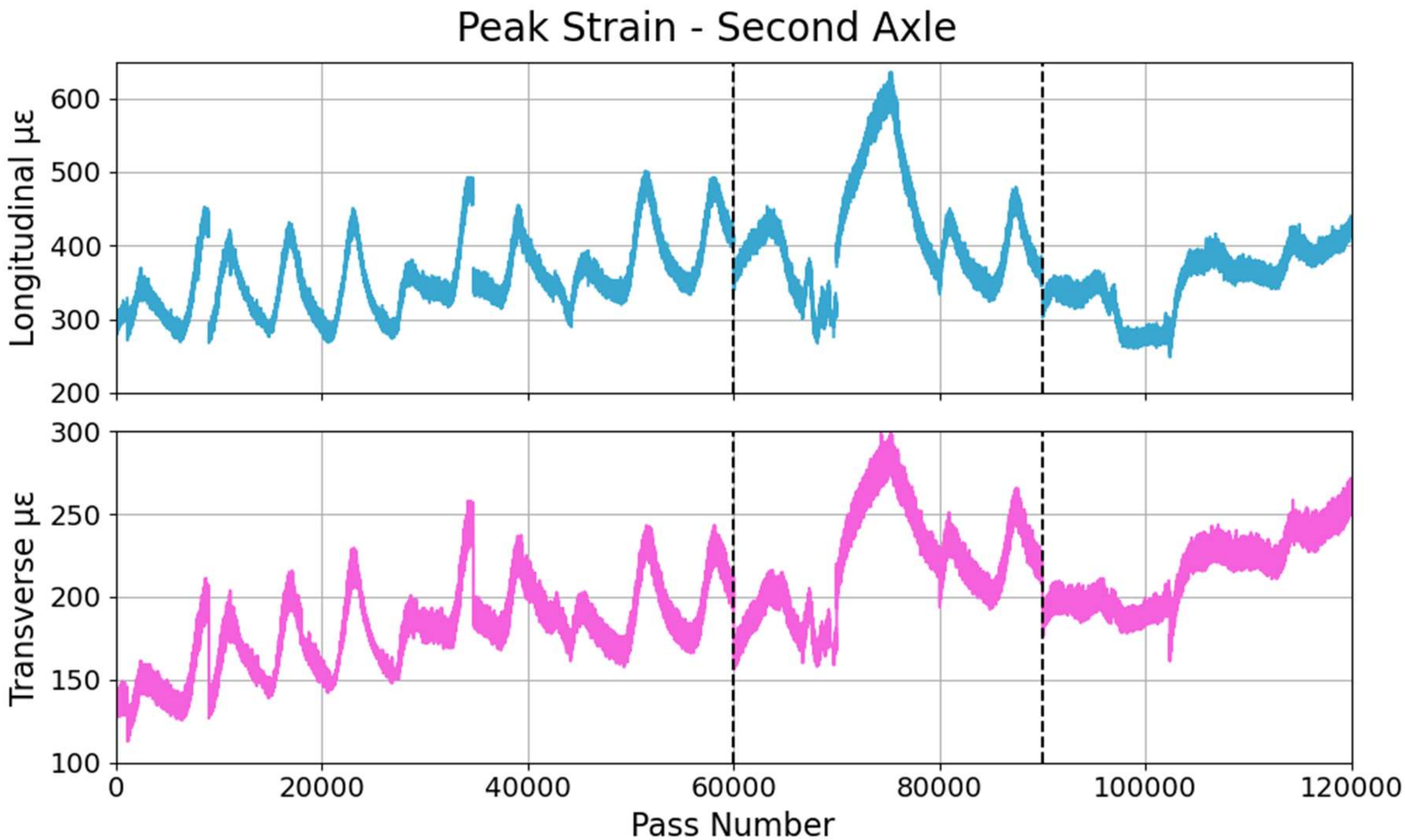
Vertical Pressure (Rutting Test)



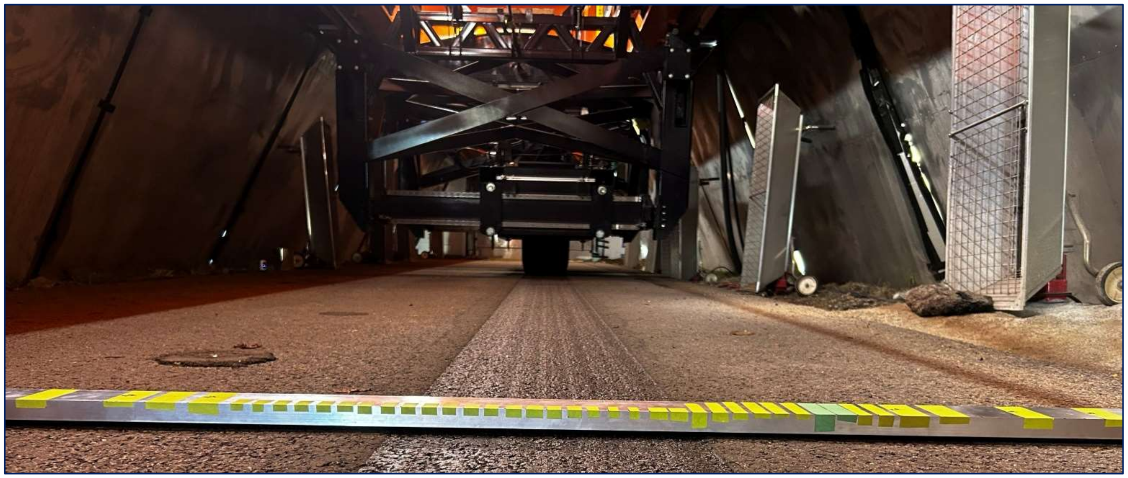
10kips/tire

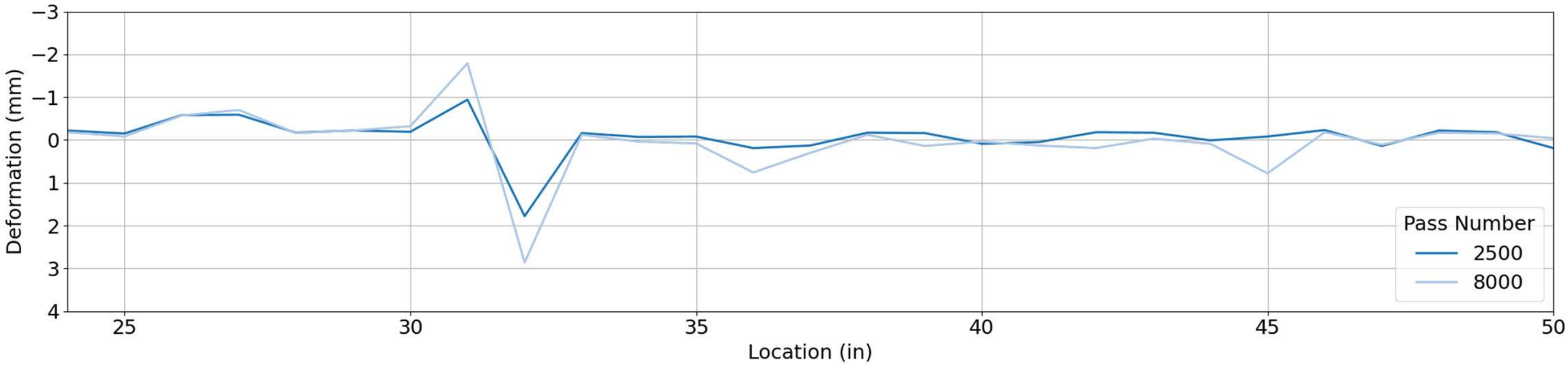


Effect of Temperature + Damage (Rutting Test)

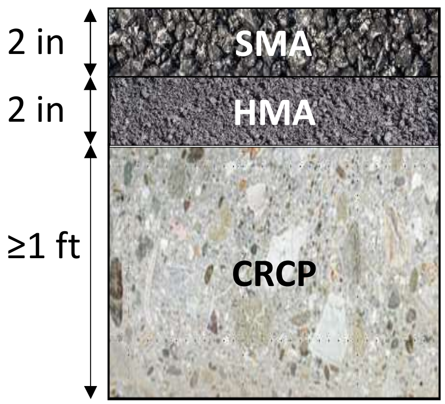


Damage Progression



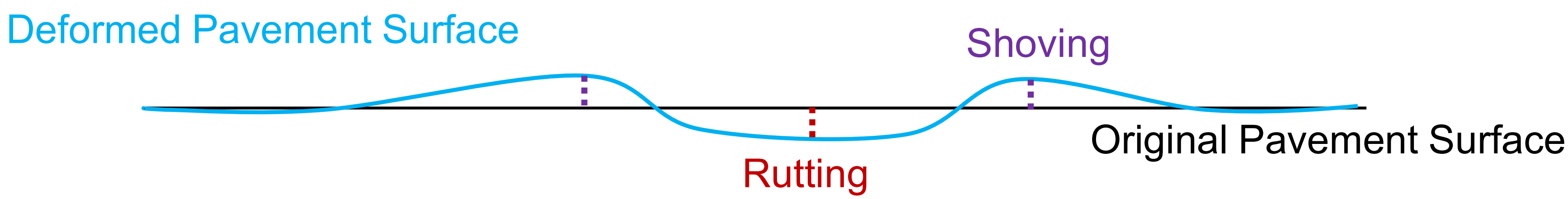


Results for First Section: D4-50-12.5-0



Aggregate: Dolomite of the highest L.A. abrasion loss.

- 400,000 Equivalent Single Axle Loads (ESALs)



Acknowledgements

- IDOT
- R27-216 technical research panel members
- ICT students, engineers, faculty, and staff
- Participant aggregate and asphalt producers

THANK YOU

Questions?

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